

AMENDMENTS TO THE CLAIMS

Please amend the claims as shown below.

1. (Five times amended) A mutant prenyl diphosphate synthase having a modified amino acid sequence, wherein

 said mutant prenyl diphosphate synthase comprises an aspartic acid-rich domain having the sequence, $D_1D_2X_1X_2(X_3X_4)D_3$, in region II of said mutant prenyl diphosphate synthase

 wherein each of D_1 , D_2 , and D_3 denote an aspartic acid residue; X_1 , X_2 , X_3 , and X_4 are each independently any amino acid and X_3 and X_4 are each optionally independently present in the aspartic acid rich domain,

wherein said region II of said mutant prenyl diphosphate synthase comprises said aspartic acid-rich domain and is greater than about 25% homologous with the sequence consisting of positions 72 through 93 of SEQ ID NO:1,

 and wherein said mutant prenyl diphosphate synthase comprises (1) at least one amino acid substitution, said at least one amino acid substitution located at at least one amino acid position selected from (a) an amino acid between D_1 and the amino acid residue at the fifth position upstream of D_1 and (b) the amino acid residue located one amino acid position upstream of D_3 ; (2) at least one additional amino acid inserted between D_3 and the first amino acid upstream of D_3 ; or (3) a combination of [(2)] (1) and [(3)] (2);

wherein said mutant prenyl diphosphate synthase synthesizes a greater amount of a prenyl diphosphate of a first chain length [prenyl diphosphate which is shorter] than is synthesized [prenyl diphosphate synthesized] by a corresponding wild-type prenyl diphosphate synthase [enzyme];

wherein said first chain length of prenyl diphosphate is shorter than a second chain length of prenyl diphosphate synthesized by said wild-type prenyl diphosphate synthase;

wherein said wild-type prenyl diphosphate synthase synthesizes said prenyl diphosphate of said second chain length in greater abundance than said wild-type prenyl diphosphate synthesizes said prenyl diphosphate of said first chain length;

and wherein said wild-type prenyl diphosphate synthase may or may not synthesize said prenyl diphosphate of said first chain length.

2. (Three times amended) A mutant prenyl diphosphate synthase according to claim 1 wherein said mutant has [the enzymatic activities and] the thermo stability of wild type prenyl diphosphate synthase and synthesizes about as much or more prenyl diphosphate than the amount of prenyl diphosphate synthesized by the wild type prenyl diphosphate synthase under similar conditions.

3. (Amended) A mutant enzyme according to claim 1 wherein the reaction product of the mutant prenyl diphosphate synthase is farnesyl diphosphate.

4. (Amended) A mutant enzyme according to claim 1 wherein the prenyl diphosphate synthase is [of the homodimer-type] a homodimer.

5. (Amended) A mutant enzyme according to claim 1 wherein the prenyl diphosphate synthase is [derived from] an archaea prenyl diphosphate synthase.

6. (Amended) A mutant enzyme according to claim 1 wherein the prenyl diphosphate synthase is [derived from] Sulfolobus acidocaldarius prenyl diphosphate synthase.

7. (Amended) A mutant enzyme according to claim 1 wherein the prenyl diphosphate synthase is [a] at least as thermostable as the corresponding wild-type prenyl diphosphate synthase [enzyme].

8. (Amended) A mutant prenyl diphosphate synthase according to claim 1, wherein at least one amino acid selected from phenylalanine at position 77, threonine at position 78, valine at position 80, and histidine at position 81 [, and isoleucine at position 84] has been substituted by another amino acid, or one or more amino acids have been inserted in between isoleucine at position 84 and methionine at position 85 in the geranylgeranyl diphosphate synthase as set forth in [SEQ ID No: 1] SEQ ID NO:1.

9. (Amended) A mutant prenyl diphosphate synthase according to claim 1 wherein at least one amino acid selected from phenylalanine at position 77, threonine at position 78, valine at position 80, and histidine at position 81 [, and isoleucine at position 84] has been substituted by another amino acid, and/or two amino acids have been inserted between isoleucine at position 84 and methionine at position 85 in the geranylgeranyl diphosphate synthase as set forth in [SEQ ID No:1] SEQ ID NO:1, wherein the phenyl alanine at position 77 has been replaced with tyrosine, the threonine at position 78 has been replaced with phenylalanine or serine, the valine at position 80 has been replaced with isoleucine, or the histidine at position 81

has been replaced with leucine or alanine [, or the isoleucine at position 84 has been replaced with leucine]; or proline and serine have been inserted in between the isoleucine at position 84 and the methionine at position 85.

10. (Original) A mutant prenyl diphosphate synthase according to claim 1, wherein the mutant prenyl diphosphate synthase is derived from a native geranylgeranyl diphosphate synthase of an organism selected from the group consisting of *Arabidopsis thaliana*, *Lupinus albus*, *Capsicum annuum*, *Sulfolobus acidocaldarius*, *Rhodobacter sphaeroides*, *Rhodobacter capsulatus*, *Erwinia herbicola*, *Myxococcus thaliana* and *Neurospora crassa*.

11. (Amended) A DNA encoding an enzyme according to claim [1] 8 or 9.

12. (Original) An RNA transcribed from a DNA according to claim 11.

13. (Original) A recombinant vector comprising a DNA according to claim 11.

14. (Original) A host organism transformed with a recombinant vector according to claim 13.

15. (Original) A process for producing a mutant enzyme according to claim 1, said method comprising the steps of culturing a host transformed with an expression vector comprising a DNA coding for the mutant enzyme and of harvesting the expression product from the culture.

16. (Amended) A process for producing a prenyl diphosphate having not more than 15 carbons comprising the step of bringing an enzyme according to [claim] any one of claims 1 [or any of claims 2] to 10 or an enzyme produced by the method according to claim 15 into contact with a substrate selected from the group consisting of isopentenyl diphosphate, dimethylallyl diphosphate, and geranyl diphosphate.

17-34. (Canceled)

35. (Amended) A mutant prenyl diphosphate synthase having a modified amino acid sequence, wherein

said mutant prenyl diphosphate synthase comprises an aspartic acid-rich domain having the sequence, $D_1D_2X_1(X_2X_3)X_4D_3$, in region II of said mutant prenyl diphosphate synthase,
wherein each of D_1 , D_2 , and D_3 denote an aspartic acid residue; X_1 , X_2 , X_3 , and X_4 are each independently any amino acid and X_2 and X_3 are each optionally independently present in the aspartic acid rich domain,

wherein said region II of said mutant prenyl diphosphate synthase comprises said aspartic acid-rich domain and is greater than about 25% homologous with the sequence consisting of positions 72 through 93 of SEQ ID NO:1, and

wherein said mutant prenyl diphosphate synthase comprises (1) at least one amino acid substitution, said at least one amino acid substitution located at at least one amino acid position selected from (a) an amino acid between D₁ and the amino acid residue at the fifth position upstream of D₁ and (b) the amino acid residue located one amino acid position downstream of D₂; (2) at least one additional amino acid inserted between the first amino acid downstream of D₂ and the first amino acid upstream of D₃; or (3) a combination of (1) and (2);

wherein said mutant prenyl diphosphate synthase synthesizes a greater amount of a prenyl diphosphate of a first chain length than is synthesized by a corresponding wild-type prenyl diphosphate synthase;

wherein said first chain length is shorter than a second chain length of prenyl diphosphate synthesized by said wild-type prenyl diphosphate synthase;

wherein said wild-type prenyl diphosphate synthase synthesizes said prenyl diphosphate of said second chain length in greater abundance than said wild-type prenyl diphosphate synthesizes said prenyl diphosphate of said first chain length;

and wherein said wild-type prenyl diphosphate synthase may or may not synthesize any of said prenyl diphosphate of said first chain length.

36. A mutant prenyl diphosphate synthase according to claim 35 wherein said mutant has the thermostability of wild type prenyl diphosphate synthase and synthesizes about as much or more prenyl diphosphate than the amount of prenyl diphosphate synthesized by the wild type prenyl diphosphate synthase under similar conditions.

37. A mutant enzyme according to claim 35 wherein the reaction product of the mutant prenyl diphosphate synthase is farnesyl diphosphate.

38. A mutant enzyme according to claim 35 wherein the prenyl diphosphate synthase is a homodimer.

39. A mutant enzyme according to claim 35 wherein the prenyl diphosphate synthase is an archaea prenyl diphosphate synthase.

40. A mutant enzyme according to claim 35 wherein the prenyl diphosphate synthase is *Sulfolobus acidocaldarius* prenyl diphosphate synthase.

41. A mutant enzyme according to claim 35 wherein the prenyl diphosphate synthase is at least as thermostable as the corresponding wild-type prenyl diphosphate synthase.

42. A mutant prenyl diphosphate synthase according to claim 35, wherein at least one amino acid selected from phenylalanine at position 77, threonine at position 78, valine at position 80, histidine at position 81, and isoleucine at position 84 has been substituted by another amino acid, or one or more amino acids have been inserted in between isoleucine at position 84 and methionine at position 85 in the geranylgeranyl diphosphate synthase as set forth in SEQ ID NO:1.

43. A mutant prenyl diphosphate synthase according to claim 35 wherein at least one amino acid selected from phenylalanine at position 77, threonine at position 78, valine at position 80, histidine at position 81, and isoleucine at position 84 has been substituted by another amino acid, and/or two amino acids have been inserted between isoleucine at position 84 and methionine at position 85 in the geranylgeranyl diphosphate synthase as set forth in SEQ ID NO:1, wherein the phenyl alanine at position 77 has been replaced with tyrosine, the threonine at position 78 has been replaced with phenylalanine or serine, the valine at position 80 has been replaced with isoleucine, the histidine at position 81 has been replaced with leucine or alanine, or the isoleucine at position 84 has been replaced with leucine; or proline and serine have been inserted in between the isoleucine at position 84 and the methionine at position 85.

44. A mutant prenyl diphosphate synthase according to claim 35, wherein the mutant prenyl diphosphate synthase is derived from a native geranylgeranyl diphosphate synthase of an organism selected from the group consisting of *Arabidopsis thaliana*, *Lupinus albus*, *Capsicum annuum*, *Sulfolobus acidocaldarius*, *Rhodobacter sphaeroides*, *Rhodobacter capsulatus*, *Erwinia herbicola*, *Myxococcus thaliana* and *Neurospora crassa*.

45. A DNA encoding an enzyme according to claim 42 or 43.

46. An RNA transcribed from a DNA according to claim 45.

47. A recombinant vector comprising a DNA according to claim 45.

48. A host organism transformed with a recombinant vector according to claim 47.

49. A process for producing a mutant enzyme according to claim 35, said method comprising the steps of culturing a host transformed with an expression vector comprising a DNA coding for the mutant enzyme and harvesting the expression product from the culture.

50. A process for producing a prenyl diphosphate having not more than 15 carbons comprising the step of bringing an enzyme according to claim 35 into contact with a substrate selected from the group consisting of isopentenyl diphosphate, dimethylallyl diphosphate, and geranyl diphosphate.

STATUS OF CLAIMS AND SUPPORT FOR CLAIM CHANGES

1. (Pending) The current amendment to claim 1 further clarifying the term "Region II," may be found, for example, in claim 1, as originally filed; Figure 1 and the illustration of Figure 1 at column 4, line 60 through column 5, line 7; Example 1, column 10; and Example 4, column 12. The current amendment replacing SEQ ID NO:2 with SEQ ID NO:1 may be found, for example, in the sequence listing where SEQ ID NO:2 is the nucleic acid sequence that corresponds to the amino acid sequence listed as SEQ ID NO:1.
2. (Pending)
3. (Pending)
4. (Pending)
5. (Pending)
6. (Pending)
7. (Pending)
8. (Pending)
9. (Pending)
10. (Pending)
11. (Pending)
12. (Pending)
13. (Pending)
14. (Pending)
15. (Pending)
16. (Pending)
- 17-34. (Canceled)
35. (Pending) This claim was presented in the Response to Final Office Action filed March 31, 2006 and corresponds to claim 17 as examined in the Office Action of January 3, 2006. Claim 35 has been amended herein to further clarify the term "Region II." Support for this amendment may be found, for example, in claim 1, as originally filed; Figure 1 and the illustration of Figure 1 at column 4, line 60 through column 5, line 7; Example 1, in column 10; and Example 4, in column 12. The current amendment replacing SEQ ID NO:2 with SEQ ID

NO:1 may be found, for example, in the sequence listing where SEQ ID NO:2 is the nucleic acid sequence that corresponds to the amino acid sequence listed as SEQ ID NO:1.

36. (Pending) This claim was presented in the Response to Final Office Action filed March 31, 2006 and corresponds to claim 18 as examined in the Office Action of January 3, 2006.

37. (Pending) This claim corresponds to claim 19 as examined in the Office Action of January 3, 2006.

38. (Pending) This claim corresponds to claim 20 as examined in the Office Action of January 3, 2006.

39. (Pending) This claim corresponds to claim 21 as examined in the Office Action of January 3, 2006.

40. (Pending) This claim corresponds to claim 22 as examined in the Office Action of January 3, 2006.

41. (Pending) This claim corresponds to claim 23 as examined in the Office Action of January 3, 2006.

42. (Pending) This claim corresponds to claim 24 as examined in the Office Action of January 3, 2006.

43. (Pending) This claim corresponds to claim 25 as examined in the Office Action of January 3, 2006.

44. (Pending) This claim corresponds to claim 26 as examined in the Office Action of January 3, 2006.

45. (Pending) This claim corresponds to claim 27 as examined in the Office Action of January 3, 2006.

46. (Pending) This claim corresponds to claim 28 as examined in the Office Action of January 3, 2006.

47. (Pending) This claim corresponds to claim 29 as examined in the Office Action of January 3, 2006.

48. (Pending) This claim corresponds to claim 30 as examined in the Office Action of January 3, 2006.

49. (Pending) This claim corresponds to claim 31 as examined in the Office Action of January 3, 2006.

50. (Pending) This claim corresponds to claim 32 as examined in the Office Action of January 3, 2006.